

REMARKS

Reexamination and reconsideration of the application as amended is requested.

The Examiner states that the cross-noting amendment to the specification after the title should be deleted as redundant. The reference has been deleted.

Claim 1 is pending in the application.

Claim 1 stands rejected under 35 U.S.C. § 102(b) for purported anticipation by, or under 35 U.S.C. § 103(a) for purported obviousness over U.S. Patent No. 5,935,700 to Enomoto et al. (hereinafter "Enomoto") in view of U.S. Patent No. 5,316,714 to Yoneda et al. (hereinafter "Yoneda"). The Examiner asserts that Enomoto discloses composite particles of silica and at least one other inorganic oxide other than silica, and that suitable particles range in size from 10 nm to 2 microns. The Examiner also asserts that Enomoto teaches that the composite oxides may be employed as an organosol in alcohols, glycols, and ketones reading on the dielectric constant claimed for organic compounds in the present application. The Examiner further states that Enomoto teaches that the particles may be surface modified by silane coupling agents, and that a silica to other oxide ratio within a range of 3 to 500 may be used. The Examiner states that Yoneda teaches glycol dispersions for imparting slipperiness to polyester films. The Examiner also asserts that Yoneda teaches coupling agents with molecular polarizabilities as claimed in the present invention for treating the particulate sols.

Claim 1 of the present invention states the following:

1. An inorganic compound sol comprising a dispersion medium having a dielectric constant of from 10 to 85 and, dispersed therein, inorganic compound particulates having average particle size from about 11 to about 30 nm whose surface has been modified by an organic compound which is selected from the class consisting of vinylsilane compounds, acrylsilane compounds, epoxysilane compounds, aminosilane compounds, γ -mercaptopropyltrimethoxysilane and γ -chloropropyltrimethoxysilane, exhibiting a molecular polarizability of from 2×10^{-40} to $850 \times 10^{-40} \text{ C}^2\text{m}^2\text{J}^{-1}$, wherein the inorganic

compound particulates are composite oxide particulates composed of silica and at least one inorganic oxide other than silica, with the weight ratio of silica to at least one inorganic oxide other than silica being 3 to 500.

Particles of an inorganic compound must generally have their surfaces rendered hydrophobic for obtaining an organic solvent dispersion thereof. Thus, generally, the surface of such particulates is modified. A method of modifying the surface of such inorganic compound particulates comprises reacting, for example, a reactive monomer or a coupling agent with hydroxyl groups of the particulate surface. However, it is difficult to obtain an organic solvent sol of high dispersibility in the presence of an acid, alkali, or surfactant.

When such inorganic compound particles are used as a filler in, for example, a coating material, a hard coating agent component of an insulating film or a protective coat, adding a sol thereof to a matrix of a coating film-forming agent is likely to invite an aggregation of particulates in the matrix. Particularly, the problem has been encountered that, when the organic solvent sol is used in the presence of a cation (alkali), anion (acid), or surfactant, particulates in the sol may be aggregated and gelation may occur. For example, in order to improve the hardness, water resistance, and stain resistance of a coating material, an organic solvent sol in which the inorganic compound particulates had been dispersed has been used. However, the problem has been encountered such that the coating material becomes viscous and whitens because such an organic solvent sol has poor compatibility with the coating film-formed resin and the resin emulsion being obtained.

In the present invention, SiO₂-rich composite particles are modified by a specific organosilane selected from vinylsilane compounds, acrylsilane compounds, epoxysilane compounds, aminosilane compounds, γ -mercaptopropyltrimethoxysilane, and γ -chloropropyltrimethoxysilane, exhibiting a molecular polarizability of 2×10^{-40} to $850 \times 10^{-40} \text{ C}^2 \text{ m}^2 \text{ J}^{-1}$,

wherein the SiO₂ composite particles are composite oxide particulates composed of silica and at least one inorganic oxide other than silica.

In the organic compound sol of the present invention, the surface of the SiO₂ composite particles is modified by an organosilane selected from vinylsilane compounds, acrylsilane compounds, and epoxysilane organic compounds having a specified molecular polarizability. Therefore the SiO₂ composite particles have a desirable affinity with the dispersion media, so that the dispersion stability thereof in the dispersion media is excellent without the occurrence of aggregation of particles and gelation. Furthermore, even if an organic or inorganic acid or salt thereof is present in the inorganic compound sol, the SiO₂ composite particles would not aggregate with each other and the gelation would not occur.

When the inorganic compound sol of the present invention is blended as a filler in, for example, a coating material or a hard coating agent, the finally obtained coating is substantially free from decrease of transparency and cracking attributed to the aggregation of particles and gelation. Therefore, the inorganic compound sol of the present invention is useful as a filler to be blended in not only various coating materials and hard coating agents but also various resins.

U.S. Patent No. 5,935,700 to Enomoto et al.

In Enomoto, which has inventors in common with the inventors of the present application, the thermoplastic resin film contains 0.05 to 0.5 weight % of fine particles of composite oxide comprising silica, alkali metal oxide, and at least one inorganic oxide other than silica or alkali metal oxide, which satisfies the following expression:

$$S \geq 10,000/(D_p \cdot SG) \quad (I)$$

wherein S indicates the specific surface area (m²/g) of the fine particles of

composite oxide, Dp indicates the average diameter (nm) of the fine particles, and SG indicates the true specific gravity thereof.

Furthermore, it is stated that the surface of the colloidal particle may be modified with modifier such as an alkoxide compound such as tetraethoxy silane, triisopropoxy aluminum; a coupling agent such as a silane coupling agent and a titanium coupling agent; a low molecular or a high molecular surface-active agent such as a nonionic base, a cationic base, and an anionic base; and metal soap salt or the like such as a metal salt of a fatty acid or the metal salt of naphthenic acid to improve the compatibility with the resin.

Enomoto never discloses an organic compound selected from vinylsilane compounds, acrylsilane compounds, epoxysilane compounds, aminosilane compounds, γ -mercaptopropyltrimethoxysilane and γ -chloropropyltrimethoxysilane, exhibiting a molecular polarizability of 2×10^{-40} to $850 \times 10^{-40} \text{ C}^2 \text{ m}^2 \text{ J}^{-1}$.

First of all, Enomoto aims at raising the lipophilicity of an inorganic particle and raising affinity with thermoplastic resin.

In contrast, the present invention aims at making particulates disperse stably in sol or solution even in the presence of acids, alkalis, or surfactant. As a result, for example, the inorganic sol of the present invention is useful for cement additives added to stop water or provide strength. When the inorganic sol of the present invention is added to cement, excessively quick caking of cement is retarded because of a low gelation rate and the inorganic compound sol can easily fill up crevices. It is for this purpose that the specific compounds used modify the surface of the particulate in the sol of the invention.

As described in Enomoto, mere modification by common modifiers does not produce particulates that are necessarily excellent in stability in sol or solution in the presence of

acids, alkalis, or surfactant. Therefore, the present invention is clearly distinguished from Enomoto.

United States Patent No. 5,935,700 to Yoneda et al.

Yoneda teaches that a monodispersed glycol suspension, which includes a monodispersed suspension in a glycol of spherical fine particles of an amorphous inorganic oxide having an average particle diameter of 0.05 to 5 micrometers and a relative particle size standard deviation of 1.0 to 1.5 and containing glycol bonded to its surface, has excellent dispersion stability. This monodispersed suspension is useful as a raw material for the production of a polyester film having improved slipperiness.

However, the diameter of particles in the sol of the present invention differs from that used by Yoneda. Specifically, the particulate diameter is from about 11 to 30 nm in the invention, and the average particle diameter is 50 to 5000 nm (0.05 to 5 micrometers) in Yoneda.

The difference in particle diameter affects the dispersibility of the particle in sol or suspension.

First of all, even if the large particles of Yoneda are dispersed in solvent, a stable sol cannot be obtained. The result is a dispersion in which the large particles readily settle. Furthermore, in Yoneda, the particle is modified by a coupling agent in order to raise the affinity of particles for polyester resin. In Yoneda, the particle is not necessarily modified in order to improve the dispersibility in glycol which is a monomer of polyester.

On the other hand, the present invention has the aim of producing a stable dispersion of particulates in sol or solution even in the presence of acids, alkalis, or surfactants. As a result, for example, the inorganic sol of the present invention is useful for cement additives added to stop water or provide strength. When the inorganic sol of the present invention is added to cement, excessively quick caking of cement is retarded because of a low gelation rate and the

inorganic compound sol can easily fill up crevices. It is for this purpose that the specific compounds used modify the surface of the particulate in the sol of the invention.

Yoneda describes large particles modified by modifiers. Yoneda contains no suggestion at all pertaining to obtaining an organic sol which has excellent stability in sol or solution in the presence of acids, alkalis, or surfactants. Therefore, the present invention is clearly distinguished from Yoneda.

Combination of Enomoto and Yoneda References

The present invention teaches stabilization of a sol. Combining references because of common teachings of imparting slipperiness to polyester films does not imply a combination of the same references to teach a method of producing sol stability. The claimed particle size of the present invention is 10-30 nm ($1 \times 10^{-8} - 3 \times 10^{-8}$ m), whereas the particle size range taught by Yoneda is 0.05 to 5 micrometers (5×10^{-8} m – 5×10^{-6} m). Though the size of composite particles in the present application is not taught to be particularly limited, the particle size ranges result in a stable sol. Yoneda, in contrast, teaches the production of a stable suspension. Suspensions differ fundamentally from sols in terms of particle sizes and the propensity of the particles to settle. Because of these different propensities, the coupling agents in suspensions and sols have different primary functions. Therefore, it is not obvious that a coupling agent employed in a suspension will be suitable for use in a sol. Enomoto does not address sol stability, and refers to pH only in relation to particle size.

Neither Enomoto nor Yoneda, alone or in combination, discloses or suggests sol stability involving particles of the size taught in the present invention. Accordingly, it is believed that claim 1 is neither anticipated by nor obvious over Enomoto in view of Yoneda.

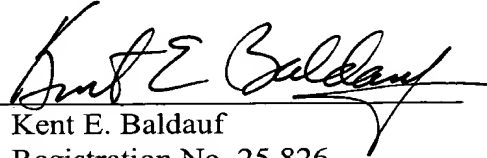
In view of the above, it is submitted that claim 1 is in condition for allowance.

Reconsideration of the rejections and allowance of the application are respectfully requested.

Respectfully submitted,

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